

Induction for classic laryngeal mask airway insertion: Does low-dose fentanyl work?

Akanksha Dutt, Anjum Khan Joad, Mamta Sharma

Department of Anesthesiology, Bhagwan Mahaveer Cancer Hospital and Research Centre, Jaipur, India

Abstract

Background: Laryngeal mask airway (LMA) insertion requires an optimal balance of anesthesia. Propofol with different opioids is a preferred combination. Two doses of fentanyl were compared for the efficacy and side effects.

Materials and Methods: 96 patients were randomly distributed into F_1 (fentanyl 1 mcg/kg) and F_2 (fentanyl 2 mcg/kg) groups. The conditions for LMA insertion, hemodynamic profile, bronchoscopic view, and incidence of sore throat were compared.

Result: There was no statistically significant difference in any parameter in the two groups except for a significant fall in systolic and mean arterial pressure in F_2 group.

Conclusion: Both doses of fentanyl (1 and 2 mcg/kg) provide comparable insertion conditions for LMA. Fentanyl in the lower dose provides a more stable hemodynamic profile.

Key words: Bronchoscopic view, fentanyl, insertion conditions, laryngeal mask airway

Introduction

Insertion of laryngeal mask airway (LMA) requires sufficient depth of anesthesia for jaw muscles to relax and suppression of airway reflexes for the device to be tolerated within the hypopharynx without undue coughing, gagging, and patient movement.^[1] Such conditions are provided by a generous dose of an intravenous (IV) anesthetic induction agent. Propofol itself does not have analgesic activity and when used alone, the high doses required for induction may cause adverse cardiovascular effects.^[2] Fentanyl has been reported to provide satisfactory conditions for insertion of LMA without administration of muscle relaxants. We compared insertion conditions for LMA silicone classic using propofol in a fixed dose (2.5 mg/kg) and fentanyl in two doses, i.e., 1 and 2 mcg/kg.

Address for correspondence: Dr. Anjum S Khan Joad, Bhagwan Mahaveer Cancer Hospital, JLN Marg, Malviya Nagar, Jaipur, India.
E-mail: anjumjoad@hotmail.com

Materials and Methods

After approval from the hospital Research and Ethical Committee, a prospective, randomized double-blind study was conducted on patients of American Society of Anesthesiologists (ASA) grades 1 and 2, between 18 and 60 years of age, undergoing elective surgery (modified radical mastectomy, mastectomy, or superficial surgery of the upper limb). The exclusion criteria were risk of aspiration and regurgitation, mouth opening < 2.5 cm, weight < 40 kg or > 110 kg, respiratory tract pathology, cervical spine disease, and an anticipated difficult airway.

An informed consent was obtained from all patients. Patients were randomly allocated using sealed envelope technique to two groups of 52 each. Fentanyl was used in a dose of 1 mcg/kg in the F_1 group and 2 mcg/kg in the F_2 group. All patients were fasted for over 6 h and premedicated with oral diazepam 0.1 mg/kg. Intraoperative monitoring included electrocardiogram, noninvasive blood pressure, oxygen saturation, end-tidal carbon dioxide, and airway pressure.

Following preoxygenation, ondansetron 0.1 mg/kg IV was given. The study drug, fentanyl 1 or 2 mcg/kg was given IV over 10 s by an anesthesiologist blinded to the drug dose. Two minutes after administration of this, propofol 2.5 mg/kg was injected IV over 1 min. The jaw thrust was used as an indicator of adequate depth of anesthesia.

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In all patients, a classic silicone LMA was inserted by an experienced anesthesiologist using index finger technique. After adequate depth of anesthesia was attained, the patient's head was extended, neck flexed, jaw opened, and the LMA was inserted. The cuff was inflated with air in 3 ml increments until the LMA tube was seen to rise slightly out of patient's mouth. The anesthesiologist was blinded regarding dose of fentanyl. On attempting LMA insertion, if mouth opening was not adequate, further bolus doses of propofol were given in increments of 10 mg IV.

Time taken from induction and number of attempts taken were noted in both study groups. After three failed attempts, the patient's trachea was intubated. In case LMA insertion took more than 20 s or more than three attempts were required, it was considered as failure and the case was excluded from statistical analysis. The heart rate and blood pressure were recorded by a blinded assessor.

Optimal ventilation was assessed by the following criteria:^[3] adequate chest expansion, square wave capnography, and stable oxygenation. Following successful LMA insertion, position of LMA was assessed using fiberoptic bronchoscope and graded.^[4,5] LMA insertion conditions were graded on a three point scale using six variables^[6] – mouth opening, ease of LMA insertion, swallowing, coughing, patient movements, and laryngospasm [Table 1].

Anesthesia was maintained with isoflurane, nitrous oxide in oxygen, and vecuronium bromide using a standard technique. On completion of the surgery neuromuscular block was antagonized with neostigmine and glycopyrrolate. LMA was removed after deflating the cuff when the patient regained consciousness. Patients were evaluated for sore throat in the immediate postoperative period and for 24 h thereafter.

In a pilot study, fentanyl 1 mcg/kg with propofol 2.5 mg/kg given 3 min prior to LMA insertion, was found to provide excellent insertion conditions in 80% of patients. Based on this data, a sample size of $n = 96$ was required to show an improvement of 15% (95%) in LMA insertion success rate with $\alpha = 0.05$ and a power of 80% with fentanyl in a dose of 2 mcg/kg. Sample size was calculated using Medcalc (Medcalc Software, Mariakerke, Belgium). Statistical analysis was done using chi-square method. Hemodynamic parameters were analyzed by "t" test.

Results

The patients in both groups were comparable in terms of age, weight, ASA status, and airway (Mallampati grade). Three patients in each group were excluded from analysis as

they needed tracheal intubation as LMA insertion took more than 20 s or more than three attempts were required. Overall LMA insertion and fiberoptic score was comparable [Tables 2 and 3] as was time taken and number of attempts [Table 4].

There was a significant (a fall of 20% from baseline value) decrease in systolic blood pressure ($P < 0.05$) at 1, 2, 3, 4, and 5 min and mean arterial pressure at 2 and 3 min after LMA insertion in F₂, but this fall in blood pressure was not clinically relevant and did not need any intervention. The heart rate did not show any significant changes in either

Table 1: LMA insertion score

Variables		Scoring	
Mouth opening	Nil (1)	Partial (2)	Full (3)
Ease of insertion	Impossible (1)	Difficult (2)	Easy (3)
Swallowing	Gross (1)	Slight (2)	Nil (3)
Coughing/gagging	Severe (1)	Mild (2)	Nil (3)
Patient movement	Vigorous (1)	Moderate (2)	Nil (3)
Laryngospasm	Severe (1)	Mild (2)	Nil (3)

Total score of 18 considered as excellent, 16–17 as satisfactory, and below 16 as poor.

Table 2: LMA insertion score

		F – 1	F – 2	P value
Mouth opening	Full (3)	33	38	0.352
	Partial (2)	15	10	
	Nil (1)	0	0	
Ease of insertion	Easy (3)	40	43	0.551
	Difficult (2)	8	5	
	Impossible (1)	0	0	
Swallowing	Nil (3)	44	42	0.738
	Slight (2)	4	6	
	Gross	0	0	
Gag/Cough Hiccough	Nil (3)	41	44	0.522
	Mild (2)	7	4	
	Severe (1)	0	0	
Head and limb	Nil (3)	38	41	0.593
	Moderate (2)	10	7	
	Vigorous (1)	0	0	
Laryngospasm	Nil (3)	48	48	0.154
	Mild (2)	0	0	
	Severe (1)	0	0	
Over all conditions for LMA insertion	Excellent (18)	24	32	0.154
	Satisfactory (16-17)	21	12	
	Poor (<16)	3	4	

Statistically significant if P value < 0.05.

Table 3: Fiberoptic scoring of the position of LMA^[4,5]

Group	Fiberoptic score				Total
	A	B	C	D	
Fentanyl 1 mcg/kg	27	16	4	1	48
Fentanyl 2 mcg/kg	29	13	5	1	48

A. Vocal cords fully visible. B. Vocal cords and posterior epiglottis visible. C. Vocal cords and anterior epiglottis visible. D. Vocal cords not seen but ventilation adequate

Table 4: Time taken and attempts taken to insert LMA

	Fentanyl (1 mcg/kg)	Fentanyl (2 mcg/kg)	P value	Significance
Time taken for LMA Insertion (sec.)	15.7 ± 9.479	14.5 ± 7.098	0.48	NS
Mean Supplemental dose of Propofol (mg)	7.08 ± 18.1	5.625 ± 15.97	0.67	NS
No. of Attempts 1/ 2/ 3	44/1/3	43/2/3	0.842	NS

Statistically significant if P value < 0.05

group though the incidence of bradycardia (heart rate < 60 beats per minute) was higher (16%) in group F_2 compared to group F_1 . Two of these patients needed atropine IV to reverse bradycardia. Incidence of sore throat was comparable immediately after recovery and 24 h after recovery in both groups.

The overall conditions for LMA insertion, mean time taken, total number of attempts taken for insertion, fiberoptic view, and incidence of sore throat were comparable in both study groups. There was a significant fall in systolic blood pressures and mean arterial pressure and higher incidence of bradycardia in the group receiving fentanyl 2 mcg/kg. The patients who received fentanyl 1 mcg/kg remained more hemodynamically stable compared to those receiving fentanyl 2 mcg/kg in our cancer patient population.

Discussion

Induction regime for LMA insertion should provide a depth of anesthesia with a relaxed jaw and suppressed airway reflexes. The optimal insertion conditions for LMA insertion include a relaxed jaw, adequate mouth of opening, and suppressed airway reflexes. This study was designed to compare the insertion conditions when propofol is used with two doses of fentanyl.

A dose response study^[7] conducted to predict an optimal dose of fentanyl (placebo and fentanyl 0.5, 1.0, 1.5, and 2.0 mcg/kg) coadministered with propofol 2.5 mg/kg for inserting the LMA Classic™ laryngeal mask airway, concluded that a standard fentanyl dose of 1.0 mcg/kg coadministered with propofol 2.5 mg/kg provided optimal conditions in 65% of cases. In our study 32 cases (66.7%) in F_2 group and 24 cases (50%) in F_1 group had excellent insertion conditions. Satisfactory insertion conditions were found in 25% cases and 43% cases with fentanyl 2 and 1 mcg/kg, respectively.

More patients responded adversely to LMA insertion in the F_1 group but on statistical analysis both groups had comparable results. In this study, four patient responses to LMA insertion were graded. These were swallowing, coughing-gagging, movement (purposeful), and laryngospasm.

Patient movement was encountered most frequently and

was seen in 20% in group F_1 and 14.5% in group F_2 . This differs from that of a study comparing LMA Classic insertion conditions following coadministration of alfentanil–propofol and fentanyl–propofol,^[6] which found swallowing to be the most common patient response to LMA insertion. The incidence of coughing-gagging in our study was low with seven patients (14%) in fentanyl 1 mcg/kg group and four patients (8%) in the second study group developing it. Wong *et al.*^[7] found that higher doses of fentanyl were associated with a notable increase in the incidence of coughing and laryngospasm and attributed these episodes to fentanyl rather than to LMA insertion.

Laryngospasm was not encountered by us in either study group possibly because we ensured adequate depth of anesthesia and obtundation of airway reflexes, by waiting for 3 min after administration of fentanyl, before attempting LMA insertion. We also used the jaw thrust to assess adequate depth of anesthesia before attempting to insert the LMA.

Kodaka *et al.*^[8] studied the effective concentration of propofol for 50% of attempts to secure laryngeal mask insertion (predicted EC50 LMA) using a target-controlled infusion. The predicted EC50 LMA of all fentanyl groups (0.5, 1.0, and 2 mcg/kg) was significantly lower than that of control group, but neither of the fentanyl groups showed a significant difference. Bi-spectral index (BIS) values after fentanyl 1 and 2 mcg/kg were significantly greater than in control and fentanyl 0.5 mcg/kg groups. There were no differences in hemodynamic responses among any groups for any trend.

We found that with a fixed dose of propofol there was a statistically significant decrease in systolic blood pressure (P < 0.05) at 1, 2, 3, 4, and 5 min and mean arterial pressure at 2 and 3 min after LMA insertion in group F_2 . The fall was however not clinically relevant and no intervention was needed. The heart rate did not show any significant changes in either group even though the incidence of bradycardia (heart rate < 60 beats per minute) was higher (16%) in group F_2 compared to group F_1 . This difference in the incidence of bradycardia was not statistically significant.

In patients with poor hemodynamic profiles (e.g., ASA 3 and 4, patients with history of ischemic heart disease, patients with valvular heart disease/using beta blockers), where a

tight control of blood pressures and heart rates would be required, the same fall in pressures could become clinically significant. Bradycardia would also have a deleterious effect in such patients. In such cases fentanyl 1 mcg/kg would be a better option, as it would provide optimum LMA insertion conditions along with a more stable hemodynamic profile.

Our results indicate that as the preadministered dose of fentanyl was increased from 1 to 2 mcg/kg, the supplementary doses of propofol required for facilitating LMA Classic™ insertion decreased, even though this decrease was not statistically significant. The supplementary dose of propofol needed by group F₁ was 7.083 + 18.1 mg and group F₂ it was 5.625 + 15.97 mg. Kodaka's^[8] study is in concordance with our findings.

The fiberoptic view depends on the alignment of LMA bowl and glottis and the extent to which the epiglottis is down folded during insertion.^[9] We did not find any statistically significant difference in the fiberoptic view scores in either study group. We had a low rate of immediate postoperative sore throat as compared to Brimacombe and others (0–50%):^[9,10] 33% in fentanyl 1 mcg/kg and 20% in fentanyl 2 mcg/kg group. There was no significant difference in the time taken for LMA insertion as well as the number of attempts required in both the groups even though the time taken for LMA insertion was 5 s in two patients in the fentanyl 2 mcg/kg group. In majority of patients (about 90% in each group) the time taken for LMA insertion was in the range of 6–10 s.

We were unable to find any published data, comparing time taken for LMA insertion using two doses of fentanyl. However, in a study by Lee *et al.*^[11] on adult patients breathing 8% sevoflurane for induction of anesthesia, pretreatment with low dose fentanyl (1 mcg/kg) and propofol (0.5 mg/kg) was found to significantly decrease the time taken for LMA insertion when compared with induction with sevoflurane alone.

The combination of propofol and fentanyl facilitated Classic

LMA insertion. Optimal conditions for insertion were obtained with both doses of fentanyl, i.e., 1 and 2 mcg/kg, when propofol was used in a dose of 2.5 mg/kg. Fentanyl 1 mcg/kg provided a more stable hemodynamic profile, with fewer episodes of hypotension and bradycardia.

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